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SCIENCE

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SHERBURNE WESLEY BURNHAM,
1838–1921

WE record, with deep regret at his passing, but with high appreciation of his long and valuable service to astronomical science, the death of Sherburne Wesley Burnham, *emeritus* professor of practical astronomy at the Yerkes Observatory, of the University of Chicago.

Born on December 12, 1838, in the upper valley of the Connecticut, at Thetford, Vermont, Mr. Burnham had the ordinary advantages of the district school, supplemented by some study in the local academy, but he did not go to college. He became an expert stenographer and shorthand reporter, long before the days of the typewriter, and this was his profession for some thirty years. During the Civil War he served in his professional capacity with the Union Army while it was occupying the city of New Orleans. He came to Chicago, after the close of the war, and became attached to the United States Courts.

His interest in astronomy must have developed very early in the sixties, for he purchased his first telescope during a visit to London in 1861; and in 1870 he became the possessor of a fine six-inch refractor, a masterpiece of Alvan Clark, which he had ordered in 1869. Mr. Burnham's vision was extraordinarily keen, for among the 451 new double stars which he discovered with that instrument many were found by other observers to be extremely difficult to resolve with much larger instruments.

In 1873 and 1874 he sent five lists of new double stars to the Royal Astronomical Society, which were published in the *Monthly Notices*. At first he had no micrometer, and was obliged to give estimated angles and distances. A correspondence developed with Baron Ercole Dembowski, who gladly made

the micrometric measurements, with his excellent skill, using a refractor of 162 mm. aperture at Gallarate, in Italy. Two lists covering 136 new double stars were printed in the *Astronomische Nachrichten* in 1875 and 1876. A short list followed in the *American Journal of Science* in 1877 and in *Monthly Notices* for the same year. In 1879 his new doubles from Nos. 483 to 733 were published in the forty-fourth volume of the *Memoirs* of the Royal Astronomical Society, together with micrometric measures of 250 other stars.

During the years from 1877 to 1881 and 1882 to 1884, Mr. Burnham had the use of the splendid 18½ inch Clark refractor of the Dearborn Observatory, then set up in the tower attached to the old Chicago University.

In 1879 he was requested by the trustees of the Lick Trust to test the conditions on Mt. Hamilton. He took his 6-inch refractor, now equipped with circles and a driving clock, to Mt. Hamilton and made observations from August 17 to October 16. His highly favorable report settled the choice of Mt. Hamilton as the site for the Lick Observatory. In 1881 he went again to Mt. Hamilton, by request, and observed the transit of Mercury with the 12-inch telescope.

During some six months of 1881 he was astronomer, under E. S. Holden, at the University of Wisconsin, where the 15.5-inch telescope of the Washburn Observatory had recently been erected. While there he discovered and measured 88 new double stars; and he measured a large number of double stars "Selected from his MS. General Catalogue of Double Stars, as specially needing observation." These observations appeared in Vol. I. of the *Publications of the Washburn Observatory* in 1882. Mr. Burnham's famous 6-inch refractor ultimately become a part of the equipment at Madison.

On the inauguration of the Lick Observatory in 1888, with Professor Holden as director, Mr. Burnham received the appointment as astronomer, and thus had abundant opportunities for the use of the great 36-inch Clark refractor for the continuance of his work. At the Lick Observatory he introduced the principle of using the telescope for all it was worth while the sky permitted: in other words, no part of the night when the sky was clear was given up for any bodily weariness of the observer. In 1892, owing to certain conditions at Mt. Hamilton which were unacceptable to Mr. Burnham, he returned to Chicago, where he was offered the highly responsible position of Clerk of the United States Circuit Court. Incidentally he was receiver of the Chicago and Northern Pacific Railroad Company from 1897 to 1902.

Mr. Burnham was in charge of the expedition from Lick Observatory to observe, at Cayenne, the solar eclipse of December 21–22, 1889. Good results were secured, due in no small measure to Mr. Burnham's large experience in photography. The report was written by Burnham and his associate, Mr. Schaeberle, and published in 1891 in a small volume from the Lick Observatory.

On the inauguration of the Yerkes Observatory in 1897, Burnham became an active member of the staff, making his observations throughout the nights of Saturday and Sunday and returning to his duties in the court on Monday morning. In 1902 he resigned his position with the court, despite the life tenure of that office. This gave him more time for his astronomical studies, but he still retained his residence in Chicago, coming to Williams Bay for observations on two nights in the week. He became Professor *emeritus* in 1914, at the age of 75, the statute of the University of Chicago requiring retirement at 70 having thus far been waived in his case. Although the opportunity for using the 40-inch telescope still remained open to him as before, he hardly availed himself of it, and his last observations here were made on May 13, 1914.

Vol. II. of the *Publications of the Lick Observatory* contain his observations from August, 1888, to June, 1892, and his fourteenth to nineteenth catalogues of new double stars discovered at the Lick Observatory in that period, including the numbers from β 1026 to β 1274. The search for new doubles was made chiefly with the excellent 12-inch telescope. He also found some new nebulæ,

and measured the positions of numerous planetary nebulæ which are given in the same volume. His orbits for several of the more interesting systems on which he had been working appear at the end of that volume. It will be seen that Mr. Burnham had largely given up the search for new double stars while at the Lick Observatory, regarding it as more important that accurate observations should be made of the systems already discovered, particularly those for which large instruments were necessary.

Vol. I. of the *Publications of the Yerkes Observatory,* issued in 1900, is entitled "A General Catalogue of 1290 Double Stars Discovered from 1871 to 1899 by S. W. Burnham." It gives in order of right ascension the history of all of the Burnham stars up to β No. 1290. Aside from his own observations, it summarizes the results of all other observers of these stars and gives diagrams and orbits, by the author and others, of several interesting systems. He did not allow himself to be distracted from his specialty by the allurements of other fields of observation: it was seldom that he looked at nebulæ unless there were double stars to be measured therein; and he had no time for observing comets, however interesting. He made an exception in locating Halley's comet on September 15, 1909, two nights after it had been first caught on a photographic plate by Wolf at Heidelberg: thus Burnham's eye was the first to see the comet, then an extremely faint speck, on this return to perihelion.

During the beginning of Mr. Burnham's use of the 6-inch telescope, he felt the great need of a single catalogue of all double stars in the Northern Hemisphere and he therefore arranged a manuscript catalogue of all known double stars within 121° of the north pole. This was conveniently indexed and proved of great service to the observer. He revised it in two MS. editions, the third of which allowed ample room for expansion and is still in use. The preparation of this catalogue had entailed a great amount of labor, as it was constantly kept up to date. Mr. Burnham says of it that "very few will fully appreciate the enormous amount of hard work which has been necessarily expended in the preparation of such a work. . . . It should be remarked in this connection that with the exception of the four years from 1898 to 1902 all this astronomical work, with the telescope and otherwise, has been done when eight or more hours of at least six days in the week were very much occupied with other and different affairs of life." After his retirement from active observations, Mr. Burnham turned this MS. catalogue and the responsibility of its up-keep over to Professor Eric Doolittle, whose premature death in 1920 is much lamented. From him, by prior arrangement, this passed on to Professor Robert G. Aitken, of the Lick Observatory, who thus carries on the work which will eventually result in a new edition of the "General Catalogue of All Double Stars," now to be mentioned. Efforts had been made for many years to have this great work published, but it could not be brought about until the Carnegie Institution of Washington in 1905 undertook to publish it. The composition was done with great care by the University of Chicago Press, and Part I. was published before the close of 1906. It lists 13,665 double stars and summarizes the numerical information about them, in a quarto volume of 275 pages. Part II., of 1,086 pages, gives details of all important observations of the pairs, with many diagrams. It constitutes a *magnum opus* of which any scientist could be justly proud.

With the 40-inch telescope of the Yerkes Observatory, Mr. Burnham gave no time to the discovery of new doubles. In fact, he avoided them, if possible, and occasionally mentioned seeing some which he did not record. In recent years he took a good deal of interest in the determination of the proper motions of the brighter stars by micrometrically connecting them with neighboring faint stars, for which a negligible proper motion could be assumed. This work was largely to lay the foundation for a greatly increased knowledge of proper motion in the future. Mr. Burnham realized very fully the great advan-

tage in accuracy that such relative positions, obtained with a telescope of long focus, had over absolute measurements with the meridian circle. His extensive observations in this direction appeared in 1913, in Publication No. 168 of the Carnegie Institution of Washington under the title: "Measures of Proper Motion Stars Made with the Forty-Inch Refractor of the Yerkes Observatory in the Years 1907 to 1912." This is a quarto volume of iv + 311 pages and includes a total of about 9,500 measures.

The great General Catalogue contained Mr. Burnham's otherwise unpublished work at Yerkes from 1899 to 1906. Between 1907 and 1911 six extensive papers of his observations appeared in *Astronomische Nachrichten,* and a final collection of measures in the *Astronomical Journal* in 1918.

It will be inferred that Mr. Burnham was a very systematic as well as industrious observer. The writer recalls his answer, to the usual inquiry of what kind of a night he had had, that he had measured 100 pairs besides setting on a number of other stars which were too close to be separated under the particular conditions of "seeing." It should be remembered that these observations were made with a refractor having a focal length of 63.5 feet, and the accomplishment of so much with so large an instrument implies every economy of time in passing from one object to another. His program was very carefully drawn up and no time was wasted in reversing the telescope, which was always pointed toward the east of the meridian so as to "keep ahead of the game."

Mr. Burnham's experience in the courts gave him a critical view of scientific evidence which is not enjoyed by all scientists. His attitude toward new discoveries, except by men in whom he had confidence, was one of some reserve. It was hard for him to believe that there could exist stars of such short periods as the many found among the spectroscopic binaries; but he ultimately came to believe the results from his confidence in the men who obtained them. In a discussion, his premises were often broad, but his logical processes were usually very accurate, so that the conclusions were sound unless he was too tolerant with his premises.

Although an expert in amateur photography, and fully appreciative of the remarkable pioneer work of his colleague Barnard in various astronomical applications of photography, still Mr. Burnham seemed to have a lingering doubt as to the superiority of modern astrometrical procedure on the dry plate, with the use of rectangular coordinates, as compared with the visual use of the micrometer for position angle and distance.

Of a genial nature, Professor Burnham had many friends, and was devoted to them; his regard for some of the federal judges with whom he had been associated was little short of veneration. He always expected that any astronomer passing through Chicago would call upon him; and at least enjoy his hospitality at luncheon.

The duties of his regular life did not make it possible for him to attend many of the meetings of the so-called learned societies. We do not find a record of his having attended a meeting of the Royal Astronomical Society, of which he was a loyal member from 1874 and of which he was elected an assssociate in 1898. In 1894 he received the Gold Medal of the Society for his researches and the annual address was by the then president, Sir William Abney, who has lately died at an advanced age. The honorary degree of A.M. was bestowed upon Mr. Burnham by Yale University in 1878; the honorary degree of Sc.D. in 1915, by Northwestern University. The Lalande Prize of the French Academy of Sciences was awarded to him in 1904.

The impress left upon his branch of astronomy by Mr. Burnham has been equalled only by his great predecessors, the Struves, Wilhelm and Otto; the Herschels, William and John; and Baron Dembowski—for all of whom he had the greatest admiration, and to the last of whom his "General Catalogue" was dedicated.

Mr. Burnham married in 1868 Mary Cleland, who survives him, with their three sons

and three daughters, together with eight grandchildren.

He had been in feeble health for the past two or three years, and suffered a broken hip from a fall, toward the end of February. He died on March 11, 1921, at his home in Chicago.

EDWIN B. FROST

YERKES OBSERVATORY,

THE CENTENNIAL EXPEDITION OF INDIANA UNIVERSITY TO PERU

BETWEEN June, 1918, and June, 1919, the Irwin Expedition of Indiana University as a part of its work collected the fishes in the highlands of Peru, particularly in the Urubamba valley from the headwaters at La Raya, elevation 14,150 feet, to Santa Ana, 3,000 feet. This work was done by Dr. C. H. Eigenmann and Miss Adele Eigenmann. Collections were made in the upper Huallaga basin between its headwaters about Cerro de Pasco and Goyllarisquisca down to near Tingo Maria, 1,800 feet, mostly by the present writer. Further collections were made from Lake Junin, 13,500 feet, near Cerro de Pasco, in the Mantaro basin to Huancayo, 10,500 feet, by myself and the Eigenmanns. Collections were also made from the headwaters of the Tarma River at Tarma, 10,000 feet, down to La Merced, about 2,500 feet, by the Eigenmanns. The Irwin Expedition thus collected in the headwaters of the Huallaga and Ucayali Rivers from their sources to the neighborhood of 2,000 feet above sea level.

In May of 1920 I started on the so-called Centennial Expedition of Indiana University to carry the survey of the fish fauna to the lower levels of the rivers of eastern Peru. The expedition was assisted by a grant from the Bache Fund of the National Academy of Sciences, and by the hearty cooperation of the Peruvian government, which provided free transportation and other assistance within Peru.

The writer traveled alone, so far as the English-speaking personnel of the expedition is concerned, depending solely upon local aid. At times help was volunteered by interested individuals or solicited from the local authorities, civil and military. Three weeks of the initial portion of the trip (from the Perené to the Ucayali) were spent in company with Professor J. Chester Bradley and Dr. W. T. M. Forbes, of the Cornell Entomological Expedition.

The plan of the present expedition has been to collect as exhaustively as posible the fishes of a few suitable, representative localities in the basins of the above-named rivers, comprised for the most part within the great Department of Loreto. Entering by Lima, Tarma and La Merced, the writer began where the Irwin Expedition left off two years ago, and crossed to the head of navigation of the Pichis-Pachitea-Ucayali system by the Via Central. Ten days were required to traverse the final 200 kilometers of this atrocious trail. It is an endless succession of mudholes, yet the principal and almost sole means of communication between coastal Peru and her transandine provinces.

No real hardship is involved in making this journey, thanks to the series of government *tambos,* or shelter houses, at convenient distances, which cater very well to those who come well recommended. This is otherwise a region entirely devoid of inhabitants.

Ten days were spent at Puerto Bermudez. Two days by canoe brought the party to a point on the Pichis to which the steam mail launch could ascend. Thenceforward travel was chiefly by launches, mail and commercial, which abound in Loreto; the shorter trips into tributary streams and lakes were made in dugouts. A month was devoted to the vicinity of Contamana on the lower Ucayali, a fortnight to the Puinahua and Pacaya, and an equal period to the region of Iquitos. The markets of Iquitos are in season very well supplied with fresh fish of great variety. Another month was spent in cruising the upper Marañon from Iquitos to the Pongo de Manseriche, and the tributaries Tigre and Morona. A three-week sojourn in and about Yurimaguas allowed an examination of the lower Huallaga, the third of four great rivers

of Peruvian Amazonia. I had during the Irwin Expedition collected on the upper portion of this river.

These streams, the Ucayali, Marañon, and Huallaga, are comparable in size to the Ohio at flood stage. All arise in the Andes and form a vast confluent flood plain parallel to the mountains, and 500–600 miles in extent. Though 2,000–2,500 miles from the mouth of the Amazon, this plain is only 400 feet above sea level. In all this stretch there is very little topographic relief. The annual fluctuation in level of the Amazon at Iquitos is 40 feet. The annual inundation therefore extends far inland from the rivers. Large numbers of cut-off lakes (*cochas*) with their connecting *cañas* form a network throughout the system, which becomes one body of water with the coming of winter rains. Most of them are dead-water bayous of varying dimensions. There are almost no brooks—all depressions (*quebradas*) only serving to receive the backwater of the rivers. The smaller tributary rivers vary greatly in their flow at all seasons, fluctuating both with the local rainfall and with the level of the outlet. A stream flowing very rapidly now may display almost no current within a few hours, or vice versa.

The extent of the navigable portion of the streams in Peru is much greater than in most Brazilian streams. Many of the latter are interrupted not far from their mouths by impassible rapids. The Brazilian river basins are sharply separated from each other by chains of hills. To the Loretan the slightest rise is a *cerro*—mountain. Any stretch of terrain not inundated is an *altura*. Every riffle is a *pongo*—rapid. Within the past few years even the redoubtable Pongo de Manseriche, by which the Marañon breaks through its last chain of the Andes, has been passed by no fewer than five steam launches. It has always been risked by raft and canoe.

The above conditions allow many species of fish from the lower Amazon to become distributed to the very foot of the Andes, and throughout oriental Peru. One finds many fishes extending from one extremity of Loreto to the other.

With the annual subsidence of the water there is of course everywhere a local sorting of species according to preferred habitat. Thus in a given stream one may not obtain more than two, three, or half a dozen species at the same time. Rarely are more than this number brought up in a single haul of a seine. (Bates called attention to this fact seventy years ago.) The *cochas* usually produce more species, but spaced pretty well apart. To get them all one must draw the seine many times in various parts of the lake. The common fish that one is obliged to reject may surfeit even one's native helpers. There is a pretty rigid assorting of fishes into river and lake forms, despite the fluvial origin of the lakes, and despite the inundations.

The great diversity of arboreal animals on the land is paralleled in the water by the large number of families of fishes and of aquatic mammals represented. The region is yet virtually tourist-free. One may journey by steamers and launches without seeing much of the teeming life of forest and river, or of primitive human life. Only in the tributary streams, traveling by canoe, does one encounter them. Here the dolphin, manatee, otter, alligator, capybara, tapir, etc., still abound, and one comes surprisingly near seeing all the animals which he had hoped to encounter.

The year 1920 was remarkable for its unusual rainfall. Not only was the curve for the depth of the Amazon at Iquitos higher throughout April and May than for many years, but also throughout the dry season. The lowest stage reached was some seven feet higher than the mean minimum depth.

The exceptional inundation of April and May had destroyed much of the crops. There was a serious shortage of all staples (plantains, beans, yucca, rice, etc.) and considerable hardship among the improvident. At no time were the sand bars of the Marañon or Amazon exposed. This of course affected the fishing industry. Seining was made much more difficult, while throw-net fishing was probably increased, due to the concentration of the *mijanos*, schools of shore fish. Much

of the time the fish had taken to the *monte*, or thicket, when the overflow of *cocha* and *quebrada* reached into the forest. While the fish are in the woods, the Loretan abandons his diet of fresh fish, and resorts to his supply of the dried.

Certain fishes are very abundant. But there is an increasing scarcity of others. The famed *pirarucú* (*paiche* of Peru) has undoubtedly been exterminated from certain regions. In the Chanchomayo dynamiting has greatly reduced the river fishes. The government has now found it possible to prevent the sale of dynamite to the poor thereabout, but has found no way of curbing the practise of dynamiting on the part of the wealthy and influential. Poisoning streams wholesale by means of the crushed root of the native poison plant *cube* is prohibited by law. But this method continues to prevail wherever *cube* is available, notably in the tributaries of the Huallaga, the smaller of which are nearly depopulated of fish.

Some birds are also rapidly becoming scarce, especially the egrets, whose plumes are marketed. Two brothers Hoyle of Contamana have secured recently a government monopoly of the plume trade of the Ucayali. They are bound by its terms to develop the fisheries of the Ucayali, first as a means of rearing fish to feed the egrets, and secondarily for the sake of restocking the streams. How to enforce respect of their charter, and how to develop a fisheries industry from nothing, without experience, are two large problems confronting the concessionaires. They do not seem to regard it a difficult matter to secure a revocation of the American law forbidding the importation of egret to this country.

Seventy years ago Bates predicted the rapid extinction of the turtles of the Amazon. In spite of an enormous consumption of turtles and eggs that has continued from that day to this, they are still very abundant. Petroleum has replaced turtle oil since that time, but turtle eggs, meat, and viscera continue to be favorite articles of food.

An effort was made by the expedition to confirm the widespread urinophilous reputation of the *candirú* (*carnero* of Peru). A Briggs' lead-in trap properly baited was frequently placed in rivers in the hope that it might demonstrate such a tropism. This was never successful. Nor did careful inquiry ever lead to the finding of an authentic case of parasitism of man by this fish. That it is strongly tropic to flesh or blood has been demonstrated.

Politically and economically eastern Peru is in an unpromising state. Its isolation from maritime Peru leads to prohibitive transportation costs in that direction. Thus all the business of the region is thrown to the Amazon. The shipping companies of the Amazon and the commercial houses of Iquitos control the economic life of the country. The country is still so new as to be in its period of destructive exploitation, and by reason of its remoteness can not compete in the world markets on any other basis. Due to the low post-war price of cotton, the people are turning from agriculture to the more or less forlorn hope of developing gold and petroleum.

The *Oriente* of Peru was not found by the writer to be, as we are encouraged to believe, wholly a land of dismal forests, swamps, noxious animals, and fevers. All these elements are present in quantity, certainly, but by no means universally distributed. Only once have I seen a large boa, and very few small snakes. Mr. Mitchell of Yurimaguas states that he has seen but four boas in twenty years' residence in Amazonia. Some rivers, *e.g.*, the Pacaya, are full of alligators, but many rivers have almost none. Only one region visited, that of the upper Marañon, was badly infested with fever. Insect pests were numerous, and of many sorts, but not so intolerable as often represented by travelers.

The realization of Humboldt's dream does not seem imminent. Such difficulties as those of transportation, climate, inundation, and an untaught, unambitions population, must be overcome before Peruvian Amazonia shall come to her own.

WILLIAM RAY ALLEN

SCIENTIFIC EVENTS

ILLINOIS STATE PARKS

THE following bill was introduced in the House by Mr. Kaufmann on March 8:

Section 1. Be it enacted by the people of the state of Illinois, represented in the general assembly: The Department of Public Works and Buildings shall have control, supervision and management of all state parks, already established or acquired hereafter.

Sec. 2. The department may purchase, lease, receive by donation or devise or take options on tracts of lands suitable for public parks, forests, game and fish preserves, and experiment and investigation stations. The department may also acquire by condemnation proceedings in the name of the state of Illinois under the laws regulating to eminent domain. Such proceedings shall be conducted by the Attorney General at the request of the department.

Sec. 3. From time to time as tracts of land are acquired, the department shall establish public parks, public playgrounds, forests, game and fish preserves, and experiment stations. It shall improve and beautify such tracts of land and bodies of water and provide for making them accessible to the general public by improved highways, leading to and driveways within such tracts.

Sec. 4. The tracts of land acquired for the state by the Department shall be kept in their natural state of beauty and only necessary structures or structures expressly authorized by law shall be erected therein. State parks and preserves shall not be operated for pecuniary profit, nor concessions for the use of them, or any part of them, or of any buildings, be leased or rented to persons for the carrying on of any business.

Sec. 5. The department shall have all necessary power to secure the proper control and policing of the state parks and preserves and shall take all necessary measures for the preservation of state property. It shall appoint such custodians and park police as it may deem necessary, and shall make reasonable rules for the regulation of the use of such state parks by the public. Regulations and rules for the conduct of the general public may be posted in conspicuous places in the state parks.

Sec. 6. Whoever: (1) Wilfully destroys, injures or defaces a guide-post, sign, fence, enclosure or structure within a state park or preserve; or (2) Wilfully destroys, injures or removes a tree, shrub or plant or flower within a state park or preserve; or (3) Violates any reasonable regulation adopted by the department and published by posting in conspicuous places, is guilty of a misdemeanor and shall be punished by a fine of not less than five dollars and not more than one hundred dollars or by imprisonment for not more than three months or by both fine and imprisonment.

Sec. 7. That Sections 1, 2, 5, 6, 7, 8, 8½, 10 and 11 of "An Act in relation to the acquisition, control, maintenance, improvements and protection of state parks, and making an appropriation to carry into effect the provisions of this Act," approved June 10, 1911, in force July 1, 1911, as amended, are repealed.

Sec. 8. There is appropriated to the Department of Public Works and Buildings, the sum of five hundred thousand dollars ($500,000) for the biennium commencing July 1, 1921, two hundred and fifty thousand dollars ($250,000) for the first year, and two hundred and fifty thousand dollars ($250,000) for the second year, for the acquisition and improvement of tracts of land and the establishment thereon of parks, preserves and experiment stations, as provided in this Act, and improvement of tracts of land and the establishment thereon of parks, preserves and experiment stations, as provided in this Act.

Sec. 9. This appropriation is subject to the provisions of "An Act in relation to State finance," approved June 10, 1919, in force July 1, 1919.

INDUSTRIAL FELLOWSHIPS OF THE MELLON INSTITUTE

THE following table presents the number of industrial fellowships which have been founded in the institute from March to March of each year, 1911 to 1921; the number of industrial fellows (research chemists and engineers) who have been employed; and the total amounts of money contributed for their maintenance by the industrial fellowship donors (industrialists and associations of manufacturers).

The total amount of money contributed by industrial firms to the institute for the ten years ending March 1, 1921, was $1,534,273. During the ten years, the institute itself expended approximately $470,000 in taking care of overhead expenses—salaries of members of the permanent staff and office force, maintenance of the building, purchase of books and

the above sums, an amount of money now apparatus, etc.—in connection with the operation of the industrial fellowships. Besides this amount, the building and permanent equipment of the institute, represent an investment of about $350,000. In addition to running into several million dollars, has been spent by the industries in developing into large scale manufacture various processes worked out at the institute.

March to March	Number of Fellowships	Number of Fellows	Total Foundation Sums
1911–1912	11	24	$ 39,700
1912–1913	16	30	54,300
1913–1914	21	37	78,400
1914–1915	21	32	61,200
1915–1916	36	63	126,800
1916–1917	42	65	149,100
1917–1918	42	64	172,000
1918–1919	47	77	238,245
1919–1920	47	83	293,680
1920–1921	48	83	320,848

APPOINTMENTS COMMITTEE FOR RUSSIAN SCIENTIFIC AND LITERARY MEN

THE following appeal has been issued from the International Research Council, Burlington House, London.

Many Russians, distinguished in various branches of learning, are at present scattered over European countries. Some of them are destitute, others are earning a precarious livelihood by work in which they have no opportunity of exercising their particular capabilities, while, at the same time, the world at large is losing the benefit of their knowledge and aptitude.

With the view of assisting our unfortunate colleagues we have formed ourselves into a committee, the object of which is to bring their names and qualifications to the notice of universities and other institutions which may be able to offer them suitable employment.

We feel that we may count upon your sympathy, and in the hope that you may be able to help, we are forwarding a list of names, at present known to us, of those who would gratefully accept positions where they could continue the work to which they have devoted their lives.

The committee will have its central office in London, but it is proposed that cooperation between different countries be secured, either by the formation of similar committees, or by the cooption of corresponding members.

The committee consists of Sir Arthur Schuster, F.R.S., foreign secretary, Royal Society (Chairman); Viscount Bryce, F.R.S.; Sir Richard Gregory, editor of *Nature;* Sir Frederick Kenyon, president of the British Academy; Charles Scott Sherrington, president of the Royal Society; Ernest H. Starling, F.R.S., professor of physiology, University of London; Sir Paul Vinogradoff, F.B.A., professor of jurisprudence, University of Oxford, and Charles J. Martin, F.R.S., director, Lister Institute, London (Hon. Secretary).

THE VISIT OF MADAME CURIE

THE following chemical societies have appointed committees to make arrangements for the reception of Madame Curie next May:

The American Chemical Society: Edgar F. Smith, chairman, L. H. Baekeland, Marston T. Bogert, Wilder D. Bancroft, Chas. F. Chandler, Chas. H. Herty, S. C. Lind, W. H. Nichols, Chas. L. Parsons, W. A. Noyes, Ira Remsen, T. W. Richards, J. E. Zanetti, B. B. Boltwood.

The American Electrochemical Society: W. S. Landis, chairman, H. B. Coho, Colin G. Fink, E. P. Mathewson, J. W. Richards.

The Société de Chimie Industrielle, American Section: George F. Kunz, chairman, L. H. Baekeland, M. T. Bogert, C. A. Doremus, J. E. Zanetti.

The Society of Chemical Industry, American Section: S. R. Church, chairman, H. G. Carrell, Chas. H. Herty, R. H. McKee, Allen Rogers.

The Chemists' Club of New York City: J. E. Zanetti, chairman, Ellwood Hendrick, M. T. Bogert, J. E. Teeple, Reston Stevenson, S. A. Tucker.

As Madame Curie is expected to be but a very short time in New York City, and as it would be impossible for her to attend functions given by any of the individual societies, the above named committees have appointed an Executive Committee, consisting of Edgar F. Smith, chairman, W. S. Landis, vice-chairman, S. R. Church, George F. Kunz, J. E. Zanetti, secretary-treasurer, to arrange for an entertainment to be given by all of the above named societies.

The committee has decided to give a luncheon in honor of Madame Curie at the Hotel Waldorf Astoria on Tuesday, May 17, and invitations have been sent to all the members of these societies living in and around New York. The headquarters of the committee are at The Chemists' Club, 52 East 41st Street, New York.

President Harding has through Mr. Arthur Brisbane subscribed fifty dollars to the Madame Curie Radium Fund. He writes: "I am so anxious about the success of the program to present to this distinguished woman a gram of radium that I would like to have a small part toward making the necessary provision."

LECTURES BY PROFESSOR EINSTEIN

Although Professor Einstein came to the United States primarily in the interests of the Zionist movement, he is giving scientific lectures at various universities. On April 15, he lectured in German on the theory of relativity at Columbia University, under the auspices of the departments of mathematics, physics, astronomy and philosophy, being introduced by Professor Pupin. Professor Einstein was awarded the Barnard medal by Columbia University last year on the recommendation of the National Academy of Sciences.

On April 18, 19, 20 and 21, Professor Einstein gave four lectures before the College of the City of New York on the following subjects: "The 'special' relativity theory;" "Generalized relativity and gravitation;" "The physical significance of entropy and quanta;" "Light-ether and radiation."

Princeton University has arranged five lectures on the theory of relativity on the afternoons from May 9 to 13, the subject of these lectures, which will be delivered in German, are first and second "Generalities on the theory of relativity," (without going deeply into the mathematical symbolism); third "Special theory of relativity," fourth "General theory of relativity and gravitation," fifth "Cosmological speculations." Scientific men are invited to the lectures. Admission will be by ticket, application for which should be forwarded to Professor H. D. Thompson, Princeton, N. J.

SCIENTIFIC NOTES AND NEWS

The American Philosophical Society is meeting in Philadelphia on Thursday, Friday and Saturday of the present week. The evening address is by Professor James H. Breasted, of the University of Chicago. The National Academy of Sciences meets at Washington on Monday, Tuesday and Wednesday of next week. The Prince of Monaco will make an address in the U. S. National Museum on Monday evening.

Dr. F. B. Jewett, chief engineer of the Western Electric Company and formerly professor of physics and engineering at the Massachusetts Institute of Technology, has been elected a vice-president and director of the company. He will continue his present work in charge of the technical forces of the telephone manufacturing industry.

Dr. Warner Jackson Morse has been appointed director of the Maine Agricultural Experiment Station. Since 1906 he has been connected with the Experiment Station, serving as plant pathologist since 1909. Dr. Morse succeeds Charles D. Woods, the circumstances of whose relations to the trustees have been stated in Science.

The governor of Massachusetts has recommended to the executive council Dr. Richard P. Strong, who holds the chair of tropical medicine at the Harvard Medical School, as a member of the Public Health Council, Boston.

Dr. William E. Musgrave has resigned as director of the University of California Medical School to accept the secretaryship of the state medical society and will edit the *California State Journal of Medicine*. Dr. Musgrave will continue his directorship of the Children's Hospital.

Dr. J. T. Willard, dean of general science and vice-president of the Kansas State Agricultural College, has been elected president of the Kansas Research Council. Dr. W. A.

Lippincott, professor of animal husbandry at the college, has been elected secretary.

DR. GEORGE H. SHULL, of Princeton University, has been appointed delegate of the American Philosophical Society to the second International Congress of Eugenics, which will be held in New York City in September.

AT its last meeting the Rumford Committee of the American Academy of Arts and Sciences voted an appropriation of $200 to Professor Alpheus W. Smith, of the Ohio State University, in aid of his research on the Hall, Nernst and allied effects.

THE prize of 25,000 marks, established two years ago by the late Berlin bacteriologist, Professor Hans Aronson, has been awarded to Professor von Wassermann, for his investigations on the Wassermann reaction.

DR. F. H. Hatch has been appointed technical adviser to the British Mines Department on questions relating to the metalliferous mining industry.

WE learn from *Nature* that at the anniversary meeting of the Royal Irish Academy on March 16 Professor Sydney Young was elected president in succession to the Reverend Dr. Bernard, provost of Trinity College, Dublin. Professor C. S. Sherrington, president of the Royal Society, was declared an honorary member in the section of science under the statute by which presidents of the Royal Society are honorary members of the academy.

AT the annual general meeting of the Ray Society on March 10 the following officers were reelected: *President:* Professor W. C. McIntosh. *Treasurer:* Sir Sidney F. Harmer. *Secretary:* Dr. W. T. Calman. The Right Hon. Lord Rothschild was elected a vice-president, and Mr. E. E. Green, Mr. Chas. Oldham, and Sir David Prain were elected new members of the council.

DR. AND MRS. N. L. BRITTON, of the New York Botanical Garden, accompanied by Dr. F. J. Seaver, have gone to Trinidad, in order to continue the botanical exploration of that island. They expect to return about the first of May.

PROFESSOR F. L. STEVENS, of the University of Illinois, will go to Honolulu about the first of May to spend several months studying and collecting Hawaiian fungi, and arranging the mycological collection of the Bishop Museum.

J. W. GIDLEY, assistant curator of vertebrate paleontology at the National Museum, has gone for a two-month exploration trip in Arizona, California and Nebraska, for the United States Geological Survey and to secure fossil mammals for the museum collection.

"A LAKE as a going concern" was the subject of an address by President E. A. Birge, of the University of Wisconsin at the annual dinner of the Wisconsin Academy of Science, Arts and Letters, held at the University Club, Madison, on April 16. Dr. Birge is the retiring president of the academy.

DR. LUDWIK SILBERSTEIN, Research Laboratory, Eastman Kodak Company, will give a major course in physics at the University of Chicago during the summer quarter, 1921. It will deal with the theory of relativity, gravitation and electro-magnetism.

DR. ALBERT H. EBERLING, of the Rockefeller Institute for Medical Research, lectured at Mount Holyoke College on April 8, on "Cultivation of tissues in vitro, with lantern slide demonstration."

A LECTURE was delivered April 11, 1921, before the Rochester Historical Society on the subject "Explorations in China" by Frederick G. Clapp. The same speaker addressed the Rochester Engineering Society at lunch on that day, the subject being "Engineering in China." Both talks were illustrated by lantern slides.

THE following special lectures are being given at 5 P.M. in the main lecture hall of Cornell University Medical College, New York City.

April 11. "The influence of the rate of growth on structural efficiency," Professor Charles R. Stockard.

April 19. "An informal talk," Professor F. Gowland Hopkins.

May 5. "Glimpses backward into the history of metabolism," Professor Graham Lusk.

May 9. "The urinary sugar secretion," Professor S. G. Benedict.

The Dean and Chapter of Westminster Abbey have decided to place a bronze medallion in the Abbey as a memorial of Sir William Ramsay.

We learn from the *Journal* of the American Medical Association that at a recent meeting of some of Sir William Osler's students, an Osler Memorial Association was formed for the purpose of founding an Osler memorial lectureship at the University of California, which will provide for an annual lecture on a scientific subject. The expense will be met by a yearly assessment of the members of the association. Dr. George H. Whipple, president of the California Academy of Medicine, has advised that the academy will be glad to cooperate in securing lecturers and in sharing the expense. Dr. John M. T. Finney, Baltimore, has accepted an invitation to deliver the first lecture.

On February 24, the Berlin Ophthalmological Society held a special session in honor of the semicentennial of Albrecht von Graefe's death. The only living former assistant of Graefe, the ophthalmologist Professor Julius Hirshberg, now seventy-eight years of age, delivered the memorial address.

Dr. Henry Platt Cushing, for thirty years professor of geology in Western Reserve University, Cleveland, and for about the same time geologist in the Adirondack region for the Geological Survey of New York, died on April 14.

The late Harold C. Lloyd, a British subject residing in São Paulo, has bequeathed all his property in São Paulo to the Instituto Oswaldo Cruz, of which Professor Carlos Chagas is director, at Manguinhos, near Rio de Janeiro. The bequest is to be applied exclusively to promote research on prevention and treatment of infectious diseases.

The appropriation by Congress to the Forest Products Laboratory, at Madison, Wis., has been increased by approximately $100,000.

By the will of the late Dr. Alexander Muirhead, F.R.S., who was associated with Sir Oliver Lodge in work on wireless telegraphy, and who died on December 13, aged seventy-two, the Royal Society of London receives the sum of £3,000.

With the aid of a gift from Dr. Adolph Barkan, emeritus professor of the Stanford Medical School, the university is gathering in the Lane Library of the medical school in San Francisco a collection on the history of medicine. Dr. Barkan will give $1,000 a year for the next three years, to which the university will be able to add from the income from certain Lane Library Foundations $1,500 a year, making a total fund of $7,500, all of which will be expended on books concerning the history of medicine. Dr. Barkan is now in Europe and he has employed an expert to aid him in getting together this collection. Dr. Barkan was professor of structure and diseases of the eye, ear and larynx in the medical school and retired from active teaching in 1911. He has before this been a liberal benefactor of the Medical School Library, having given his own library dealing with the subjects in his own special field, together with $10,000 as a fund for the purchase of other books on these subjects.

The thirty-second session of the Biological Laboratory of the Brooklyn Institute of Arts and Sciences, which is located at Cold Spring Harbor, Long Island, New York, will be held next summer. The regular course work extends from July 6 to August 16. Courses are given in field zoology by Drs. H. E. Walter, of Brown University; S. I. Kornhauser, of Denison University, and H. M. Parshley, of Smith College; in comparative anatomy by Professor H. S. Pratt, of Haverford College; in principles of genetics by Professor H. S. Fish, of the University of Pittsburgh; in systematic and field botany by Dr. O. E. Jennings, of the University of Pittsburgh, and Mr. C. A.

Stiteler; in advanced botany by Dr. J. W. Harshberger, University of Pennsylvania. Opportunities for research are freely open to independent investigators. For the announcement address the Biological Laboratory at Cold Spring Harbor, N. Y.

THE twelfth annual meeting of The American Oil Chemists' Society, formerly The Society of Cotton Products Analysts, will be held on May 16 and 17, the two days immediately preceding the twenty-fifth Annual Convention of the Inter-State Cottonseed Crushers' Association, at the Congress Hotel, Chicago. Besides the several committee reports addresses will be presented. In order to conserve time for discussion, it is planned to have abstracts of all committee reports in the hands of the members at the meeting, and to request that the discussion of these abstracts be prepared in writing in as many cases as possible. The annual banquet will be held Tuesday evening. The local committee has arranged a number of trips about the city to points of general interest to visitors and of special interest to chemists.

UNDER the auspices of the Wild Flower Preservation Society of America in cooperation with Community Center Department of the Public Schools the following lectures have been given in Washington:

February 9. The lure of Rock Creek Park: Dr. F. Lamson-Scribner.

February 16 and 23. Seeds, fruits and seedlings, Professor F. H. Hillman.

March 2. Roots and underground stems: Albert A. Hansen.

March 9. Stems, buds and their winter study: Dr. A. S. Hitchcock.

March 16. Leaf shapes, modifications and functions: Dr. Paul Bartsch.

March 25. Flowers and their functions: P. L. Ricker.

March 30. Where wild flowers grow and why: Dr. Edgar T. Wherry.

FREE public lectures were delivered in the Central Display Greenhouse of the New York Botanical Garden on Sunday afternoons during April at 3:15 o'clock, as follows:

April 3. Fiber plants: Dr. A. B. Stout.

April 10. Milk-trees and other lactiferous plants: Dr. W. A. Murrill.

April 17. Air plants: Dr. H. A. Gleason.

April 24. Desert plants: Mr. G. V. Nash.

THE fifteenth French Congress of Medicine will be held in Strasbourg from October 3 to 5, under the chairmanship of Dr. Bard, professor of clinical medicine in the University of Strasbourg. These are the subjects to be discussed: (1) the anatomic and functional adaptation of the heart to pathologic conditions of the circulation; papers by Dr. Cottin, of Strasbourg, and Dr. Demeyer, of Brussels; (2) glycemia; papers by Professor Ambard, Strasbourg; Dr. Chabanier, Paris, and Dr. Baudoin, Paris; and (3) antianaphylaxis; papers by Professor Widal, Paris; Drs. Abrami and Pasteur-Vallery-Radot, Paris, and Dr. Péhu, Lyons.

Chemical Abstracts has in process of printing a Formula Index to the 1920 volume. The indexing of chemical compounds by formulas, which is done in addition to the indexing by names, is a new departure for a chemical abstract journal. This index will contain about seven thousand entries.

THE interchange of publications between Germany and the United States, which was suspended when this country entered the World War in 1917, has been resumed by the International Exchange Service of the Smithsonian Institution.

A SCIENTIFIC expedition to Spitzbergen is being organized by Oxford University, with the necessity of procuring £3,000 to carry out the work.

A NEW launch for use at the Macbride Lakeside Laboratory of the University of Iowa on Lake Okoboji, has been provided by a gift from Mr. Felix Hirschel, of Davenport.

DURING the Boston meeting of the American Medical Association in June there will be in the room used for exhibits on the floor of the special libraries at the Boston Public Library, an exhibit of early texts (Hippocrates to Sydenham) dealing with fevers and with specific infections. These will be arranged in

chronological order. In addition to the texts, there will be considerable illustrative material touching on hospitalization and treatment, the use of baths, venesection, new remedies, pest banners, broadsides and medals, also Saint Roch and Saint Sebastian, and various aspects of the plague and syphilis dealt with in the graphic arts. General texts illustrating the Greek, Byzantine, Mohammedan and medieval practise in fevers will occupy half of the space allotted. The other half will contain tracts on the plague and syphilis, original descriptions, new diseases and primary treatises on the doctrine of contagium vivum. A descriptive catalogue will be ready for distribution at the time of the annual session.

The London County Council according to the *British Medical Journal* has adopted the recommendations of the committee appointed by the Illuminating Engineering Society to inquire into eyestrain in cinematograph halls. These recommendations will be put into force at once so far as new halls are concerned, and will be applied to existing halls as opportunity offers. The chief recommendation sets out the limit of the vertical angle of view. The committee believes that ocular discomfort arises mainly from the abnormal angle at which very often the eyes of spectators are directed upwards, and that conditions suitable for the eyes would be secured if a moderate value for the angle of elevation were adopted. It is therefore proposed that the angle of elevation subtended at the eye of any person seated in the front row by the length of the vertical line dropped from the center of the top edge of the picture to the horizontal plane passing through the observer's eye shall not exceed 35 degrees. In some of the London halls this condition is complied with, and in others it is approached, but in others again the angle in question exceeds 60 degrees.

Nature states that the members of Mr. L. H. Dudley Buxton's expedition have now returned from a stay of some weeks in the Island of Malta. The object of the expedition was to collect material for a study of the physical anthropology of this island. About 1,000 adults, men and women, were measured. The fine series of ancient bones which Professor Zammit excavated in the Hypogæum at Hal-Saflieni and elsewhere was collected together and measured. A long series of skeletal remains from a modern ossuary were also examined. A special visit, lasting for two days, was paid to Gozo by Mrs. Jenkinson and Miss Moss to work at the physical anthropology of that island. The expedition has collected an immense mass of valuable material, which will take some time to arrange and digest. As soon as this work is sufficiently far advanced Mr. Buxton hopes to submit a preliminary account of the results of the expedition to the Royal Anthropological Institute.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of Edmund Cogswell Converse, who died on April 4 in Pasadena, California, Amherst College receives a bequest of about $250,000. Of this amount $200,000 will be used for the upkeep and development of the Converse library, for the building of which Mr. Converse donated $250,000 in 1916, the building to be a memorial to his brother, James B. Converse. The remaining $50,000 of the bequest will be used to establish an Edmund Cogswell Converse scholarship fund.

The *Journal* of the American Medical Association writes that "much disappointment is being expressed in university circles in Toronto at the failure of the Ontario government to take action during the present session of the legislature on the report of their own appointed special commissions which has been inquiring into the status of the universities of the province. As the University of Toronto expected $1,000,000 from the Rockefeller Foundation there will be for the present no available funds for further expansion as it will be doubtful if even this sum will be forthcoming owing to the failure of the government to come to the assistance of the university."

THE trustees of the estate of the late John W. Sterling, to whom the residue of the estate was left in the interest of Yale University, have established two additional Sterling professorships at Yale; one of these is to be assigned for the present to mathematics, one to physiological chemistry. Professor Ernest W. Brown, of the department of mathematics, has been assigned to one of these professorships, and Professor Lafayette B. Mendel, professor of physiological chemistry has been assigned to the other. Four Sterling professorships have now been established, the other two being the new professorship of education recently filled by the appointment of Frank E. Spaulding, formerly superintendent of public schools in Cleveland, Ohio, and the new professorship of chemistry recently filled by the appointment of Professor John Johnston, formerly secretary of the National Research Council. Each of these professorships has an endowment of about $225,000. After meeting the salary of the professor, "the university shall have the right to use any surplus income of these funds in advancing the work of the said professorship through the appointment of assistants, aid in publication, opportunity for study or investigation in New Haven or elsewhere, or in other ways."

PROFESSOR PAUL H. M.-P. BRINTON, head of the department of chemistry at the University of Arizona, has accepted appointment as professor of analytical chemistry in the school of chemistry at the University of Minnesota.

PROFESSOR HALE HOUSTON, head of the department of civil engineering at Clemson College, S. C., has been elected associate professor of engineering at Washington and Lee University, the appointment being effective on September 1.

AT Stanford University associate professors have been promoted to be professors as follows: William A. Manning in applied mathematics; Leroy Abrams in botany; Jesse B. Sears in education; Thomas Addis in medicine. Assistant professors to be associate professors: Edwin W. Schultz and William L. Holman in bacteriology; William M. Proctor in education; Charles N. Cross in mechanical engineering; Frank W. Weymouth in physiology; John E. Coover in psychology. Assistant clinical professor to be assistant professor: Henry G. Mehrtens, in medicine. Instructors to be assistant professors: Elizabeth L. Buckingham, and Edith R. Mirrielees in English; Edward B. Towne in surgery; James P. Baumberger in physiology; Gordon F. Ferris in entomology (zoology).

PROFESSOR BRAUS, of Heidelberg, has been proposed as the successor to Professor O. Hertwig, of Berlin, who has sent in his resignation.

DISCUSSION AND CORRESPONDENCE

GENETICS OF THE "CHINCHILLA" RABBIT

A CONSIDERABLE interest exists in the raising of rabbits for fur, stimulated no doubt by the extensive use and high price of fur garments in recent years, and by the fact that wild fur-bearing animals are on the decrease. Rabbit fur has long been used as a substitute for other furs and sold misbranded but is coming to be used under its own name and on its own merits. One impetus to such use comes from the development chiefly in France of breeds whose fur is attractive in its natural colors. Among such breeds are the chocolate or "Havana," the French silver of "champagne d'argent," and the "Chinchilla." This last is an especially pleasing color variety of a pearl gray color. The coat is similar to that of a wild gray rabbit except that (1) it contains no yellow whatever, the yellow ticking of gray rabbit fur being replaced with white, and (2) the black portions of the gray fur are toned down to a slaty blue. Both these differences appear to follow from a single genetic change, a mutation in the color factor less extreme than that which has occurred in the white or albino variety, yet affecting the same genetic factor or "gene."

If a chinchilla rabbit is crossed with any of the common color varieties other than white, the chinchilla character behaves as a reces-

sive in heredity, in which it agrees with the behavior of the albino character. But if it is crossed with the albino variety itself, offspring are produced all of which are chinchillas, and in later generations both chinchilla and white young are to be expected. These facts indicate that it is an alternative form or allelomorph of albinism. It constitutes the fourth recorded albino allelomorph in rabbits, the series in the order of decreasing pigmentation being (1) ordinary pigmentation, (2) chinchilla, (3) Himalayan albinism, (4) ordinary albinism (snow white). A similar but not identical series of albino allelomorphs was described for the guinea pig several years ago by Sewall Wright.[1] Chinchilla seems to be substantially equivalent to the guinea-pig albino allelomorph seen in the red-eyed silver agouti variety. A homologous albino allelomorph in the rat has been described by Whiting and King,[2] under the name of ruby-eyed dilute gray.

One defect of the new fur varieties of rabbits is their relatively small size. Furriers desire larger, stronger pelts, such as can be obtained only from large-sized animals. In the case of the chinchilla variety the desired improvement can be obtained easily and speedily. The desired size is found in varieties raised chiefly for meat, such as the Flemish Giant. Various color varieties occur in this breed including the albino, known as "white Flemish." By mating a pure chinchilla with white Flemish rabbits, young will be obtained all of which will be chinchillas in color yet will have increased size, intermediate or a little greater than intermediate between the sizes of the respective parents. By further crossing of the improved chinchillas with white Flemish, still larger chinchillas may be obtained, and in a very short time the full size of the Flemish breed may be substantially secured in a rabbit having the chinchilla coat. In this process of improvement there will be no wasters, unless the fifty per cent. of whites are so regarded, for the peculiar method of inheritance renders all other young valuable, since all will be chinchillas.

W. E. Castle

Bussey Institution

[1] Carnegie Institution of Washington, Publication No. 241, 1916.

[2] *Jour. Exp. Zool.*, 26, 1918.

THE EARLY HISTORY OF LITMUS IN BACTERIOLOGY

The writer is indebted to Professor F. G. Novy, of the University of Michigan, for the correction of a statement in a recent article entitled "Chemical Criteria of Anaerobiosis with Special Reference to Methylene Blue," published in the *Journal of Bacteriology*, January, 1921, Volume 6, page 1.

The statement in question is as follows:

> "The earliest authentic reference to the bacteriological use of litmus appears to be that of Wurtz (1892) who introduced litmus lactose agar as a differential medium for *Bact. coli* and *Bact. typhosum*. It was impossible to confirm Novy's (1893) allusion (copied by Hunziker, 1902) to Buchner (1885) and Cohen (?) as first to use litmus acid and reduction changes respectively, the last reference apparently being altogether erroneous."

Professor Novy points out in a letter, which is quoted by permission, that many of the workers of that period, including himself, had used litmus for several years prior to the date of Wurtz's paper. As Professor Novy says, "Wurtz was a late comer." My reference to Wurtz as apparently the first can be defended only upon the admittedly uncertain grounds that having attempted in vain to find a reference to litmus in Buchner's article as quoted by Novy and Hunziker, and having failed to find even an article by Cohen, I took what seemed at the time the earliest authentic reference.

The following is quoted verbatim from Professor Novy's letter:

> It is true that the references are not correct; whether it be due to failure to send me proof, or to my own carelessness I am unable to say.
>
> The only reference which I give to Buchner is to E. Buchner, the chemist, and concerns his hydrogen culture work. My text (p. 597) mentioned Buchner (unqualified) and, as was more or less the custom of the day, it meant the bacteriologist, Hans Buchner. Unfortunately, through some slip no reference to his work is given.

Buchner was apparently the first to use litmus media for bacteria, although the ophthalmologist Leber preceded him by three years, employing litmus gelatine to demonstrate acid production by *Aspergillus*.

Cahen, and not "Cohen (?)," published his paper in the *Journal* given, in the next volume to that cited. While the citation is not correct as to volume and page, still with the name and *Journal* given it hardly justifies characterization as "apparently altogether erroneous."

It thus appears that both of us have been to some extent guilty and the present note is therefore offered in mutual condonation.

The following list of *authentic references* prior to 1890 was supplied by Professor Novy and each has been confirmed by the undersigned.

Leber—*Berl. klin. Wchnschr.*, 1882, 19. 163.

H. Buchner—*Arch. f. Hyg.*, 1885, 3, pp. 417, 418, 419.

Marpmann—*Centralbl. f. d. allgemeine Gesundheitspflege; Ergänzungshefte*, 1885–1886, 2, Heft 2, p. 123. (The number appeared in 1886 but the title page of the volume bears date of 1889.)

Weisser—*Ztschr. f. Hyg.*, 1886, 1, p. 334.

Cahen—*Ibid.*, 1887, 2, pp. 387, 394.

Neisser—*Virchow's Archiv. f. pathol. Anat. u. Physiol.*, 1887, 110, p. 394.

Loeffler—*Berl. klin. Wchnschr.*, 1887, 24, pp. 610, 631.

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IVAN C. HALL

UNIVERSITY OF CALIFORNIA

ANOTHER DRIFT BOTTLE WHICH CROSSED THE ATLANTIC

IN a previous note[1] the writer gave the record of a bottle which drifted from the Gulf of Maine to the Azores. Recently record has been received of a bottle which was picked up in the Orkney Islands. This bottle, No. 230, was set out on the same day (August 29, 1919) as No. 198 which went to the Azores and was put out about 6½ miles to the southeast of it, *i.e.*, 7½ miles southeast of Point Lepreaux in the Bay of Fundy. It was picked up on the Island of Papa Westray, one of the northwestern islands of the Orkney group, on January 21, 1921, about one year and five months after it was set out. This bottle probably followed the northern route of the North Atlantic wind drift ("Gulf Stream") as indicated for another bottle recorded previously.[1]

JAMES W. MAVOR

UNION COLLEGE,
SCHENECTADY, N. Y.

[1] "On a bottle which drifted from the Gulf of Maine to the Azores," SCIENCE, N. S., Vol. LIII., No. 1365, February 25, 1921. Through a misprint the writer's name was given as "James W. Moor" instead of "James W. Mavor."

NEWSPAPER SCIENCE

TO THE EDITOR OF SCIENCE: The recent press reports quoting me as saying that I had "obtained the closest approach to a perfect vacuum ever recorded" are false and without foundation. The daily press copied and added to an item in the *Utah Chronicle*, a student paper, which itself was inaccurate in saying I had "perfected the apparatus." The student reporter after seeing in the department of physics a well-known form of vacuum pump wrote the original article without submitting it to me before publication. I am taking this opportunity to deny the statements credited to me by the newspapers which have given me so much undesirable and distasteful publicity.

ORIN TUGMAN

UNIVERSITY OF UTAH,
April 8, 1921

SCIENTIFIC BOOKS

Atmospheric Pollution.[1] Sixth Report of the Committee for the Investigation of Atmospheric Pollution.

(In SCIENCE, November 28, 1919, a summary of the fourth report of this committee, on the work in 1917–18, is given.)

[1] Meteorological Office. Report on Observations for year ending March 31, 1920, London, 1921.

In all 29 gages are in operation—distributed as follows: Birmingham 3, London 8, Glasgow 9, Southport 2, and 1 each at Kingston, Malvern, Newcastle, Rochdale, Rothamsted, St. Helens, and Sterling. Two more stations are about to operate.

Full returns have been published in the *Lancet*.

The following data are given in this report:

1. Monthly deposits for the two stations representing high and low deposits.

2. Total solids deposited monthly at all stations.

3. Mean monthly deposits for summer half years, *i.e.*, April to September, 1918 and 1919.

4. Mean monthly deposits for winter half years, *i.e.*, October to March, 1918–19, and 1919–20.

5 and 6. Classification of stations according to amounts of elements.

7 and 8. Totals of classified stations for each element of pollution.

9. Comparison of mean monthly deposit during summer and winter.

10. Average deposit of each element for each month for two London and four Glasgow stations.

Also six summaries and analyses.

The station showing the highest mean monthly deposit for the year is Southwark Park, London, with 15.35 metric tons per square kilometer, but it is said that probably Newcastle or Rochdale, for which full year results were not available, might have exceeded this figure. The lowest value was 3.17 at Malvern.

The following table[2] gives the mean monthly deposits as selected stations:

MEAN MONTHLY DEPOSIT IN METRIC TONS PER SQUARE KILOMETER

Meteorological Office	8.43
Finsbury Park	10.78
Ravenscourt Park	14.09
Southwark Park	15.35
Hesketh Park	6.41
Woodvale Moss	5.34
Bellahouston Park	8.87
Botanic Gardens	10.91
Queens Park	8.01
Richmond Park	12.15

[2] Abridged. Full table gives quantities of tar, carbonaceous matter, etc.

Generally speaking there is evidence of a considerable diminution of summer deposit in practically all the districts.

The highest deposit of tar in the London group was in February, the lowest in May; while in the Glasgow group the highest was in November and the lowest in September. This may be regarded as a normal distribution, as the winter months, including the two highest deposits, are the time when domestic fires are in operation, while the lowest deposits occurring in May and September, are in the summer months when fires are presumably not required. In Glasgow there is a second minimum in December and February. Wind doubtless has a great influence on the quantity of deposit, high winds sweeping it away from the vicinity of its origin and calm weather favoring deposit near the source of impurity.

Of the research work, the chief problem has been accurate measurements of acidity in the air. Automatic filters have been devised, holding 24-hour discs and many records have been made of impurities in London air. It has been shown that there is a definite cycle in the distribution of the impurities during the 24 hours. From midnight to 6 A.M. the air is practically clean of impurity, very little being recorded except during fogs. At about 6 A.M., when fires are lit, there is an increase in impurity continuing until 11. From 11 to 10 P.M. the quantity varies very little. At 10 it begins to diminish rapidly and has almost disappeared by midnight.

The committee is considering the possibility of utilizing standard rain gages. For large deposits this might work, but for country places with small deposits the 20 cm. gage (8 inch diameter) would not suffice since the area of this gage is practically 1/10 that of the standard deposit gage. One great objection to the use of the standard rain gage is the impossibility of estimating the quantity of tar and

sulphates present; and these indicate the origin of the deposit.

To investigate this matter, however, the committee had the water collected in the 8-in. rain gage on the roof of the Meteorological Office analyzed for two or three months. During the month of November the small 8-in. gage collected 900 c.c. of water, the total deposit was 0.445 gramme, the total soluble 0.34 gramme, while in the standard deposit gage, the water collected was 783 liters, total deposit 1.962 grammes, total soluble 0.53 gramme. There was, therefore, a large excess of soluble matter in the water collected in the rain gage. The same result was found in subsequent months, and it was ascertained that the excess of soluble matter was due to metal dissolved from the rain gage.

It was therefore useless to continue the experiment unless the solution of the metal could be prevented. In order to do this the rain gage was given a coating of Duroprene varnish, in the hope that this would prevent the solution of the metal without any contamination of the water.

The result of the analysis of a month's rainfall showed for the 8-in. rain gage a considerably larger proportion of soluble and insoluble matter per liter of water as compared with the standard deposit gage, owing to the varnish yielding to the action of the rain water. It is therefore clear, if observations are to be taken with small gages these must be constructed of something which will not dissolve in the water, and the use of the ordinary copper rain gages is therefore inadmissible.

ALEXANDER MCADIE

SPECIAL ARTICLES

THE MECHANISM OF AN ENZYME REACTION AS EXEMPLIFIED BY PEPSIN DIGESTION[1]

ONE of the most striking peculiarities of living matter is the fact that nearly all the reactions which take place in the organism are due to enzymes. The mechanism of enzyme reactions is therefore very closely connected with the mechanism of the living cell. Many enzyme reactions, however, may be studied in vitro and are therefore amenable to quantitative study. The present paper is an attempt to show that the peculiarities of a typical enzyme reaction, pepsin digestion, may be explained by the accepted laws of chemical reactions and that the apparent divergencies from these laws are due to the fact that the enzyme as well as the protein with which it reacts exist in solution as equilibrium mixtures, consisting, in the case of the protein of ionized and non-ionized protein, and in the case of the pepsin of free and combined pepsin. The influence of the various factors on the digestion are primarily due to changes in these equilibria.

It is well known that enzyme reactions in general have certain peculiarities which distinguish them from ordinary chemical reactions. These may be briefly stated as follows:

1. The final amount of change caused by the enzyme is independent of the amount of enzyme present.

2. The rate of change may or may not be proportional to the concentration of enzyme present.

3. The rate of change is proportional to the substrate concentration in dilute solution but increases less rapidly than the substrate concentration in solution of higher concentration.

4. The amount of substrate decomposed in the same time interval by varying enzyme concentrations is not always proportional to the concentration of enzyme but is often proportional to the square root of this quantity (Schütz's rule).

5. The reaction proceeds most rapidly at a certain definite hydrogen ion concentration.

It has been found in a study of pepsin digestion that the above peculiarities may be quantitatively accounted for on the basis of the following mechanism.

1. The protein reacts with the acid of the

[1] The experimental data on which this paper is based may be found in *J. Gen. Physiol.*, 1918–19, I., 607; 1919–20, II., 113, 465, 471, 595; 1920–21, III., 211.

solution to form an ionized protein salt. The amount of this salt formed is determined by the hydrogen ion concentration of the solution according to the well-known laws governing the reaction of an acid and a weak base.

2. The pepsin is present in the solution, (*a*) as free, probably negatively charged pepsin, and (*b*) in combination with the products of hydrolysis of the protein. These two forms are in equilibrium with each other and their relative concentration depends on the amount of products of hydrolysis present in the solution as demanded by the law of mass action.

3. The reaction takes place between the ionized protein and the free pepsin.

EXPERIMENTAL EVIDENCE FOR THE ABOVE STATEMENTS

Loeb[2] has shown by direct experiment that the protein exists in solution in an equilibrium condition as stated under (1).

Rekelharing and Ringer[3] have shown that purified pepsin in solution is negatively charged. It may be shown by direct experiment that the addition of products of hydrolysis decrease the activity of the enzyme and that the amount of the decrease in the activity can be predicted by the law of mass action.

The validity of the third assumption may best be tested by applying the proposed mechanism to the explanation of the characteristic peculiarities of the reaction outlined under (1 to 5).

1. *Influence of Quantity of Enzyme on the Final Equilibrium.*—Since the free enzyme and the products of hydrolysis are in equilibrium there will always be some active (free) enzyme present no matter how high the concentration of products becomes. The reaction will therefore proceed to approximately the same point irrespective of the amount of enzyme present at the beginning of the reaction. It will be seen, however, that the final equilibrium will depend to a slight extent on the amount of enzyme present since some of the products of hydrolysis are combined with the enzyme.

2. *Concentration of Enzyme.*—If the enzyme solution is pure, the rate of hydrolysis, other factors being constant, will be directly proportional to the concentration of enzyme taken. If the enzyme solution contains products of hydrolysis or other substances with which the enzyme is combined then the rate of hydrolysis will increase more slowly than the concentration of enzyme solution since the amount of free enzyme present becomes relatively smaller the higher the concentration.

3. *Concentration of Protein.*—If the rate of hydrolysis of the protein is proportional to the concentration of *ionized* protein then the rate must increase more slowly than the total protein concentration since the ionization of the protein salt is less in concentrated than in dilute solution.

4. *Schütz's Rule.*—Arrhenius[4] has pointed out that in an equilibrium system, such as exists between free pepsin and the products of hydrolysis, the concentration of one of the reacting molecules or ions becomes inversely proportional to the concentration of the second as soon as the second is present in large excess. That is, the amount of free pepsin present, after the first few minutes of the reaction, is inversely proportional to the amount of products formed. It follows from this that the amount of hydrolysis at any time is proportional to the square root of the time elapsed, which is one form of Schütz's rule.

5. *The Influence of the Hydrogen Ion Concentration.*—It is clear that the more acid is added to the protein the more protein salt will be formed until all the protein is present in the form of protein-acid salt. This salt is practically completely ionized in dilute solution as may be shown by direct measurement

[2] Loeb, J., *J. Gen. Physiol.*, 1918–19, I.; 1919–20, II.

[3] Peckelharing, C. A., and Ringer, W. E., *Z. physiol. Chem.*, 1911, LXXV., 282.

[4] Arrhenius, S., "Quantitative Laws in Biological Chemistry," London, 1915, pp. 36–48.

of the anion concentration by means of concentration cells. A further increase in the amount of acid will now serve to decrease the concentration of protein ions by increasing the concentration of the common anion. The concentration of ionized protein will therefore pass through a maximum which should coincide with the maximum for the rate of digestion. If the ordinary theory of chemical kinetics, on the basis of the law of mass action, be applied to the above system, it may be predicted that:

I. The optimum hydrogen ion concentration for the digestion of the protein must coincide with the hydrogen ion concentration at which the concentration of protein ions and therefore the conductivity due to the protein is at a maximum.

II. The limiting pH for the activity of pepsin on the alkaline side must depend on the isoelectric point of the protein, since this is the point at which the protein first begins to react with the acid.

III. The addition of a salt with the same anion as the acid to a solution already containing the optimum amount of acid will have the same depressing effect on the digestion as the addition of the same amount of anion in the form of acid.

IV. The pepsin should combine with the protein only when the latter is ionized, *i.e.*, pepsin should behave the same as the inorganic anions studied by Loeb.

These predictions have been tested quantitatively and found to be fulfilled. It has also been found by direct experiment that neither the influence of the acidity on the destruction of the enzyme, nor the viscosity of the protein solution can account for the influence of the hydrogen ion concentration on the rate of digestion.

It will be seen that from this point of view pepsin digestion is a chemical reaction in which the pepsin as well as the protein takes part. It is therefore not a catalytic reaction at all in the classical sense. The specificity of the reaction is therefore probably governed by the same conditions that determine the specificity of any chemical reaction, since from a quantitative standpoint each chemical reaction is specific. It may be added that a very similar mechanism was proposed by Stieglitz and his collaborators for the hydrolysis of the imido esters by acid.

It is, of course, impossible at present to apply these results directly to the activities of the living organism since conditions there are much more complex. It is probable, however, that much of the apparent complexity is due to the fact that several processes, each simple in itself, occur simultaneously and thus lead to a complicated result. Dernby's[5] experiments render it probable that the phenomenon of autolysis may be explained in this way.

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KNIPP'S SINGING TUBE

MY colleague, Dr. C. T. Knipp, when constructing a piece of apparatus, found that one of the parts—a glass tube intended for a mercury trap—gave forth a musical sound under the heating action of a gas flame. Following this clue he constructed various modifications of the tube and described them with the interesting results obtained.[1] Inquiry has been expressed concerning the explanation of its action. It occurred to the writer that this explanation might be found in the theory advanced for similar cases where sounds are maintained by heat.[2]

Fig. 1 pictures one type of the tubes tested. It is a resonator with a loop at A and a node at N, so that the distance $ABCN$ constitutes approximately one fourth of the wave-length of the sound given out by the tube when operating.[3] The air surges back and forth at A with the greatest velocity and displacement. From this point the to and fro motion of the

[5] Dernby, K. G., *Biochem. Z.*, 1917, LXXXI., 198.

[1] *Phys. Rev.*, Vol. 15, p. 155, 1920; and other publications.

[2] Rayleigh, "Theory of Sound," Sec. 322. Barton, "Text-Book of Sound," Sec. 265–277.

[3] *Phys. Rev.*, Vol. 15, p. 336, 1920.

air grows gradually less until it becomes zero at the node *N*. Compressions and rarefactions have maximum values at *N* and grow less in intensity until at *A* there is no change in pressure. The oscillating motion will persist for a number of vibrations until the friction with the sides of the tube gradually brings about a condition of rest. If the motion is to be maintained, energy must be supplied to the vibrating system. In Dr. Knipp's apparatus, this energy is furnished at *cc* by a ring burner gas flame.

As the air surges up the tube and turns to pass into *D*, it is brought into intimate contact with hot glass at *CC*. This portion of heated air communicates its energy to surrounding air particles at *D* and results in a general rise of temperature in this region. It tends to expand the air. Just at this time, the air begins to surge in the opposite direction throughout the tube and the tendency to expand at *D* assists this return surge.

When the air surges back from *D* to *EE* it becomes heated again at *C* and the heat acquired is given up partly to the glass at *EE*, thus causing a cooling and consequently contraction. In the meantime, the air has finished its outward motion and is ready to

Fig. 1.

surge back toward the inner part of the tube. The cooled air at *EE* by its contraction assists this motion. Thus, the motion is maintained first by the heating effect (expansion) at *D* and half a period later by the cooling effect (contraction) at *EE*.

The alternating motions are quite rapid since the vibrations in the various types of tubes range from 30 to 250 times per second. It is well established that air may be heated and cooled thus rapidly because the accepted explanation for the propagation of sound in air requires this rapid change in temperature.

The amplitude of the motion at *CC* is not great but appears to have a range from 0.5 to 1.5 cm., depending on the tube used. The lower pitched tubes have the larger amplitude. The area of glass heated is small so that the temperature gradient from the red hot glass to the cooler portion 0.5 cm. distant may be several hundred degrees, thus allowing a confirmation of the theory advanced.

The additions and subtractions of heat to the air are not impulsive but, by the processes of transmission explained, gradually build up to maxima at suitable instants to maintain the motion. Cooling the tube at *BE* assists the vibration. The motion is maintained more easily if the area of the annual ring at *BEC* is made smaller than the area of the tube at *D*. This results in a greater amplitude of motion at *C* in agreement with the theory.

Mechanically, the motion may be likened to the motion of a system consisting of a spring that is fastened at one end with a weight at the other end that vibrates back and forth. (See Fig. 2.) When the mass *m* moves to the

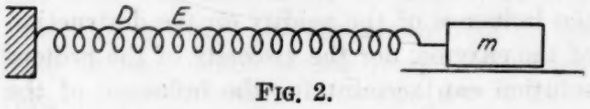

Fig. 2.

left, the spring is compressed and presently when equilibrium is reached, the motion reverses. If, at this instant, the spring at *D* could be strengthened by the insertion of several coils, the return motion would be assisted. This corresponds to the addition of heat in Dr. Knipp's tube.

When the spring has expanded to the other limit of its vibration, imagine several loops

of the spring at *EE* removed so that the tension, or pulling together of the spring, is strengthened. There is a consequent additional pull on the mass just when it is needed to encourage the motion. This effect corresponds to the cooling of the air in the singing tube at *EE*.

F. R. WATSON

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THE AMERICAN PHYSIOLOGICAL SOCIETY

THE American Physiological Society held a very successful meeting at the University of Chicago during convocation week. The scientific program covered three days of December 28, 29 and 30 with two daily sessions each. The evenings were given to general meetings and social intercourse. On the evening of December 28 the Physiologists joined with the other Biological Societies in the annual dinner of the Federation of American Societies for Experimental Biology.

The dinner is looked forward to by the membership as the annual social event of the meetings. Dr. Roswell H. Park, president of the American Society for Experimental Pathology and chairman of the executive committee for the year 1920 presided at the dinner. Addresses were made by Dr. Simon Flexner, of the Rockefeller Institute for Experimental Biology and Medicine, and Dr. William H. Howell, of the School of Hygiene and Public Health of the Johns Hopkins University. A less formal dinner was also held on the evening of December 29.

The chief events of the two business meetings of the Physiological Society were the following:

1. Announcement of the forthcoming introductory number of the new journal issued under the auspices of the society, *Physiological Reviews*, which appeared early in the new year.

2. The annual dues for 1921 were fixed at $2 by the council.

3. The council announced the appointment of Donald R. Hooker as managing editor for the *American Journal of Physiology* for 1921.

4. The council announced the appointment of Donald R. Hooker as managing editor, and Wm. H. Howell, J. J. R. Macleod, Frederic S. Lee, D. R. Hooker, L. B. Mendel, Reid Hunt and Gideon H. Wells as the editorial board for *Physiological Reviews* for the year 1921.

5. Reports of the treasurer were received and audited.

6. The officers elected for the ensuing year are:
President, J. J. R. Macleod, University of Toronto.
Secretary, Chas. W. Greene, University of Missouri.
Treasurer, Joseph Erlanger, Washington University, St. Louis.
Councilman for the term, 1921–1924, A. J. Carlson, University of Chicago.
Councilman for the unexpired term of President-elect Macleod, J. A. E. Eyster, University of Wisconsin.

7. The following new members were nominated by the council and elected by the society:

J. B. Collip, A.M., Ph.D., assistant professor in physiology and biochemistry, University of Alberta.

W. Dennis, A.M., Ph.D., assistant professor of physiological chemistry, Tulane University.

L. R. Dragstedt, Ph.D., assistant professor of physiology, University of Chicago.

F. S. Hammett, A.B., M.S., Ph.D., fellow in biochemistry at the Wistar Institute.

Fraser Harris, M.D., D.Sc., professor of physiology and histology, Dalhousie University, Halifax, N. S.

Selig Hecht, Ph.D., assistant professor of physiology, Creighton Medical College, Omaha.

Davenport Hooker, B.A., M.A., Ph.D., professor of anatomy, University of Pittsburgh, School of Medicine.

Norman M. Keith, instructor in medicine, Mayo Clinic, Rochester, Minn.

S. O. Mast, B.S., Ph.D., professor of zoology, Johns Hopkins University.

Jas. M. D. Olmsted, M.A., Ph.D., assistant professor in physiology, Toronto University.

Thos. L. Patterson, A.B., A.M., M.S., Ph.D., assistant professor of physiology, University of Iowa.

Maurice I. Smith, B.S., M.D., pharmacologist, U. S. Public Health Service, Washington, D. C.

8. A new fellowship for Research in Physiology was established under the control of the society by the generous contribution of William T. Porter, of the Harvard Medical School. Dr. Porter contributed $1,200 as an annual stipend to establish a fellowship for research in physiology under the auspices of the American Physiological Society and the administration of its council. The acceptance of the proposition was recommended by the council and accepted with appreciation by vote of the society. The fellowship will begin October 1, 1921, and is to be filled by nomination by members of

the Physiological Society and appointment by the council.

A noteworthy event of the meeting was an exhibit of old and historical books on anatomy and physiology arranged by Professor Arno B. Luckhardt, of the University of Chicago. This exhibit was open during the entire session. A very profitable scientific program was carried forward as recorded below. The society in closing its annual session passed the following resolution:

Resolved: That the American Physiological Society expresses its keen appreciation to the authorities of the University of Chicago and to the local committee for the numerous and effective arrangements that have contributed in a large degree to the scientific and social success of this the thirty-third annual session of the society.

SCIENTIFIC PROGRAM

The scientific program of research titles is recorded herewith in full:

In memoriam Samuel James Meltzer: Wm. H. Howell, Baltimore, and Simon Flexner, New York.

The volume changes in the cerebrospinal fluid under the influence of drugs: F. C. Becht, Northwestern University Medical School.

Use of hypertonic salt in experimental intracranial pressure: Ernest Sachs and J. Y. Malone (by invitation), Washington University.

Forms of infections and communicable encephalitis in man and animals: Simon Flexner.

A physiochemical method of characterizing proteins. II.: Edwin J. Cohn.

A separation of substances eliminated by the kidney into groups on the basis of the effects of changes in blood flow and temporary anæmia: E. K. Marshall, Jr., and Marian M. Crane (by invitation), Washington University Medical School, St. Louis.

The synthesis and elimination of hippuric acid in nephritis: F. B. Kingsbury and W. W. Swanson (by invitation).

A crystalline uric acid compound in beef blood: Alice Rohde Davis and Stanley R. Benedict.

Further observations on the mechanism of the keto-lytic (anti-ketogenic) action of glucose. (a) *In vitro experiments.* (b) *Data from respiration experiments on man:* P. A. Shaffer.

The lipoid balance in the blood: W. R. Bloor.

The nature of blood clotting, as viewed from the action of tissue extracts: C. A. Mills (by invitation) and G. M. Guest (by invitation).

The inhibitory influence of the cervical sympathetic nerve upon the sphincter muscle of the iris: Don R. Joseph, St. Louis University.

Consistency of protoplasm and character of amœboid movement: Leo Loeb, Washington University, St. Louis.

The internal secretion of Sandstrom's glands, parathyroid hypofunction and eclampsia: Aldo C. Massaglia (by invitation), Northwestern University Medical School.

Thyro-parathyroidectomy in the sheep: Sutherland Simpson, Cornell University.

Technique and general effects of removal of the liver: F. C. Mann, Mayo Foundation, Rochester, Minn.

The liver as a regulator of the glucose concentration of the blood and nitrogen constituents of the blood following its removal: F. C. Mann and T. B. Magath (by invitation), Mayo Foundation.

Production of ammonia in the nerve during excitation: Shiro Tashiro, University of Cincinnati.

Further experiments on the removal of the sino-auricular node: J. A. E. Eyster and W. J. Meek.

Vagal apnoea: W. J. Meek.

Heat-block in nerves: Percy M. Dawson and Elvia Ostlund (by invitation), University of Wisconsin.

Studies on the physiological effects of X-rays: (1) *On the variation in the lethal dose during metamorphoses in the fruit-fly, Drosophila:* James W. Mavor (by invitation), Union College, New York.

Readjustment of the peripheral lung motor mechanism after bilateral vagotomy: T. L. Patterson (by invitation), University of Iowa.

A study of denervated tissues: F. A. Hartman and W. E. Blatz (by invitation), University of Buffalo.

Changes in temperature and pulse rate in the rabbit during innoculations of fever: F. M. Baldwin and E. N. Miller (by invitation), Iowa State College.

The changes in the H-ion concentration coincident with the growth of bacterium tumefaciens and other plant pathogens: Wm. H. Chambers (by invitation), Washington University, St. Louis, Mo.

Difference in the H-ion concentration of the sensible, regional and total perspiration of the body: George A. Talbert, Fairmount College, Wichita, Kansas.

Plasma sodium chloride and œdema in diabetes: RUSSELL M. WILDER (by invitation) and CAROL BEELER (by invitation), Mayo Foundation, Rochester.

Respiratory changes occurring during exercise: ROY J. PEARCE, Akron, Ohio.

Further observations on the movement of the arterial walls under pneumatic compression: JOSEPH ERLANGER, Washington University, St. Louis.

Oxygen consumption during repeated slight hemorrhages: H. SCHLOMOWITZ, ETHYL RONZONI (by invitation), and H. H. SCHLOMOWITZ (by invitation), Marquette Medical School, Milwaukee, Wisconsin.

Effect of hemorrhage on the response to oxygen reduction: ROBERT GESELL, EDWARD BLAIR (by invitation), and ROBERT TROTTER (by invitation), University of California.

The rate of methemoglobin formation of carboxyhemoglobin: T. K. KRUSE, University of Pittsburgh.

Error as a criterion of industrial fatigue: E. G. MARTIN and J. P. BAUMBERGER (by invitation), Stanford University.

Salt antagonisms in artemia: E. G. MARTIN and BLAKE C. WILBUR (by invitation), Stanford University.

Hours of work in relation to the quantity of the output: A. H. RYAN and P. S. FLORENCE (by invitation), Tufts Medical College, Boston.

The response of a muscle to submaxial stimulation of its motor nerve as affected by reflex excitation and inhibition: ALEXANDER FORBES, Harvard Medical School.

On a volatile sperm-stimulating substance derived from marine eggs: G. H. A. CLOWES.

Some effects of increased and decreased oxygen pressure on embryos of ring-doves: OSCAR RIDDLE, Cold Spring Harbor, Long Island.

The fat soluble vitamine: H. STEENBOCK, MARIANA T. SELL (by invitation), and E. M. NELSON (by invitation).

Further observations on the epinephrin output of the adrenals: G. N. STEWART and J. M. ROGOFF, Western Reserve University.

The effect of adrenalectomy upon the total metabolism of the cat: JOSEPH C. AUB, J. FORMAN (by invitation), and E. M. BRIGHT (by invitation), Harvard Medical School.

The relationship of the increase in blood sugar concentration to (a) *The specific dynamic action of glucose and to* (b) *The specific dynamic action of adrenalin:* W. M. BOOTHBY and IRENE SANDIFORD (by invitation), Mayo Foundation, Rochester, Minn.

Nomographic charts for the calculation of the basal metabolic rate: W. M. BOOTHBY and R. B. SANDIFORD (by invitation), Mayo Foundation, Rochester, Minn.

Specific dynamic action of thyroxin: H. S. PLUMMER (by invitation), and W. M. BOOTHBY.

Vasomotor reactions of the nasal cavity and postnasal space to chilling of the body surface: STUART MUDD (by invitation), SAMUEL B. GRANT (by invitation), ALBERT GOLDMAN (by invitation), Harvard University.

Factors determining the duration of the consecutive phases of the cardiac cycle: CARL J. WIGGERS, Western Reserve University.

Observations on the pathological physiology of circulatory stasis in man: R. W. SCOTT, City Hospital, Cleveland, Ohio.

The relation of cottonseed poisoning to gossypol: C. L. ALSBERG and E. W. SCHWARTZE (by invitation), Bureau of Chemistry, Washington, D. C.

Experimental observations on the ureter: VINCENT J. O'CONOR (by invitation), and G. B. WISLOCKI (by invitation), Harvard Medical School.

Observations on the spread of temperature changes in tissues: N. B. TAYLOR (by invitation), University of Toronto.

An explanation for the increased oxidation following the ingestion of fats and alcohols: W. E. BURGE, University of Illinois.

An explanation for the increased oxidation after fertilization during youth, and for its decrease in old age: W. E. BURGE and J. LEICHSENRING (by invitation).

The effect of various temperatures upon blood catalase: O. O. STOLAND and LALIA WALLING (by invitation), University of Kansas.

Further observations on the results of feeding cotton meal and kernels to animals: ICIE G. MACY (by invitation), and N. M. ALTER (by invitation), Yale University and Western Pennsylvania Hospital.

The gastrin theory put to physiological test: A. C. IVY, Loyola Medical School, Chicago.

The intestinal mechanism primarily stimulated by sodium carbonate: FREDERICK S. HAMMETT (by invitation), Wistar Institute of Anatomy, Philadelphia.

The effect of pituitary extract upon the peripheral vasomotor mechanism and on diuresis: O. O. STOLAND, J. H. KORB (by invitation), R. M. ISENBERGER (by invitation), and R. W. URIE (by invitation), University of Kansas.

The quantitative measurement of static control in standing: W. R. Miles, Carnegie Nutrition Laboratory, Boston.

Blood pressure and electrocardiographic changes in the dog during extreme oxygen want: C. W. Greene and N. C. Gilbert (by invitation), Northwestern University Medical School.

PAPERS READ BY TITLE

A study of the influence of various circulatory conditions on the reaction to the low oxygen of rebreathing: Edward C. Schneider.

Endocrinological studies of the prostate gland: D. I. Macht.

Movements of the empty stomach of necturus: T. L. Patterson (by invitation).

Notes on muscle fatigue in frog when immersed in various concentrations of the alcohols: F. M. Baldwin.

Report on the daily analysis of outdoor (city) air for 18 months: W. M. Boothby and K. Sandiford (by invitation).

The effect of starvation on the catalase content: W. E. Burge and J. Leichsenring (by invitation).

Dioestrous changes in the mammary gland of the opossum: Carl Hartman (by invitation).

A new method for determining cardiac output: J. A. E. Eyster and W. J. Meek, University of Wisconsin.

Contributions to our knowledge of the center of gravity in man: Percy M. Dawson and coworkers.

Minimal reflex contractions in tenuissimus of the cat, investigated by Pratt's optical method: E. L. Porter, Western Reserve University.

Production of ammonia in muscle under different conditions: Shiro Tashiro and Olive P. Lee (by invitation).

The distribution of particulate matter after intravenous injection: C. K. Drinker, L. A. Shaw (by invitation) and C. C. Lund (by invitation), Harvard Medical School.

P-D time and D-P time of the carotid pulse of women: W. P. Lombard and O. M. Cope (by invitation), University of Michigan.

The relation of the cerebral hemispheres to the sympathetic nervous system: Fred. T. Rogers, Baylor University.

A quantitative study of the effect of magnesium chloride on nerve: Esther Creilsheimer (by invitation), and C. E. Shepherd (by invitation), University of Minnesota.

The inhibitory effects of vagus stimulation on gastric mobility in the turtle: Fred. T. Rogers and Z. Berkovitz (by invitation), Baylor University.

Experimental gigantism produced by feeding anterior lobes of hypophysis: E. Uhlenhuth (by invitation), Rockefeller Institute, New York.

DEMONSTRATIONS

Exhibition of old books of anatomy and physiology: A. B. Luckhardt, University of Chicago.

The adaptation of Adrian's narcosis experiment to class-room instruction on nerve conduction: Alexander Forbes, Harvard University.

The capillary circulation in the cat's ear: Donald R. Hooker, Johns Hopkins University.

The action of gastrin: R. W. Keeton, F. C. Koch and A. B. Luckhardt, University of Chicago.

Vasomotor nerves in the lungs of amphibia and reptila: A. B. Luckhardt and A. J. Carlson.

Models to illustrate the principles of ophthalmoscopy and retinoscopy: A. B. Luckhardt.

Appetite secretion of gastric juice in man: A. J. Carlson.

Lung automatism and lung reflexes: A. B. Luckhardt and A. J. Carlson.

Effects of prolonged low protein diet in rats: E. C. Turner (by invitation), University of Chicago.

"Fat Soluble A" in chicken fat and orange peel: Ethel Cooper (by invitation), University of Chicago.

Symbiosis in the study of deficiency diseases: Lester Dragstedt (by invitation), University of Chicago.

An anesthesia apparatus: D. E. Jackson.

An anesthesia apparatus for animal experiments: Gerard Raap (by invitation) and D. E. Jackson.

The utilization of the ciliary ganglion in physiology and pharmacology: A. R. Cooper (by invitation) and J. F. Groot (by invitation).

Demonstration of Wright's new method for the study of leucocytic chemotaxis: Elizabeth P. Wolf (by invitation).

Charts illustrating (a) *effects of spells of rest on physical efficiency.* (b) *An examination of indices of circulatory efficiency:* Percy M. Dawson, Lucy A. Wallrich (by invitation) and Frances V. Kupperman (by invitation), University of Wisconsin.

Chas. W. Greene,
Secretary